U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

SAFETY RULES FOR RADIO INSTALLATIONS

Comprising Part 5 of the Fifth Edition
National Electrical Safety Code

NATIONAL BUREAU OF STANDARDS HANDBOOK H35
(Supersedes H9)

U. S. DEPARTMENT OF COMMERCE
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NATIONAL BUREAU OF STANDARDS
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National Bureau of Standards Handbook H35

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PREFACE

This handbook contains part 5 of the fifth edition of the National Electrical Safety Code and deals with the rules for radio installation. Such of the definitions in section 1 as apply to this field, have also been included.

Transmitting stations of high power (as defined in the rules) are required to be installed in conformity with the rules of part 1 so far as generating apparatus and installation of conductors are concerned. Part 1 contains the rules for the installation and maintenance of electrical supply stations and will be found in Handbook H31 as well as in the complete code.

The present edition of these rules is the result of a revision which has been carried out according to the procedure of the American Standards Association, and the revised rules have had the approval of the sectional committee organized according to those rules. This handbook supersedes Handbook H9, which contains the fourth edition of the same rules.

A discussion of these rules will be found in a revised edition of the handbook entitled "Discussion of the National Electrical Safety Code." Criticism of the rules and suggestions for their improvement are invited, especially from those having experience in their application, and in future editions every effort will be made to perfect the rules, both in the development of detail and in the modification of any requirements which it is found can be improved.

LYMAN J. BRIGGS, *Director.*

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SAFETY RULES FOR RADIO INSTALLATIONS

COMPRISING PART 5 OF THE FIFTH EDITION, NATIONAL ELECTRICAL SAFETY CODE

DEFINITIONS

Alive or live means electrically connected to a source of potential difference, or electrically charged so as to have a potential different from that of the earth. The term "live" is sometimes used in place of the term "current carrying" where the intent is clear, to avoid repetitions of the longer term.

Antenna conflict means that an antenna or its guy wire is at a higher level than a supply or communication conductor and approximately parallel thereto, provided the breaking of the antenna or its support will be likely to result in contact between the antenna or guy wire and the supply or communication conductor.

Circuit means a conductor or system of conductors through which an electric current is intended to flow.

Communication lines means the conductors and their supporting or containing structures which are located outside of buildings and are used for public or private signal or communication service and which operate at not exceeding 400 volts to ground or 750 volts between any two points of the circuit and the transmitted power of which does not exceed 150 watts. When operating at less than 150 volts, no limit is placed on the capacity of the system.

Note: Telephone, telegraph, railroad signal, messenger-call, clock, fire or police alarm, and other systems conforming with the above are included.

Lines used for signaling purposes, but not included under the above definitions, are considered as supply lines of the same voltage and are to be so run.

Exception is made under certain conditions for communication lines used in the operation of supply lines.

Conductor means a metallic conducting material, usually in the form of a wire or cable, suitable for carrying an electric current. Does not include bus bars.

Current-carrying part means a conducting part intended to be connected in an electric circuit to a source of voltage. Noncurrent-carrying parts are those not intended to be so connected.

Dead means free from any electrical connection to a source of potential difference and from electric charge; not having a potential different from that of the earth. The term is used only with reference to current-carrying parts which are sometimes alive.

Effectively grounded means permanently connected to earth through a ground connection of sufficiently low impedance and having sufficient current-carrying capacity to prevent the building up of voltages which may result in undue hazard to connected equipment or to persons.

Electric supply equipment means equipment which produces, modifies, regulates, controls, or safeguards a supply of electric energy. Similar equipment, however, is not included where used in connection with signaling systems under the following conditions:

(a) Where the voltage does not exceed 150.
(b) Where the voltage is between 150 and 400 and the power transmitted does not exceed 3 kilowatts.

Electric supply lines means those conductors and their necessary supporting or containing structures which are located entirely outside of buildings and are used for transmitting a supply of electric energy.

Electrical supply station means any building, room, or separate space within which electric supply equipment is located and the interior of which is accessible, as a rule, only to properly qualified persons.

Note: This includes generating stations and substations and generator, storage-battery, and transformer rooms, but excludes manholes and isolated transformer vaults on private premises.

Equipment means a general term including fittings, devices, appliances, fixtures, apparatus, and the like, used as a part of, or in connection with, an electric installation.

Grounded means connected to earth or to some extended conducting body which serves instead of the earth, whether the connection is intentional or accidental.

Grounding conductor means a conductor which is used to connect the equipment or the wiring system with a grounding electrode or electrodes.

Grounded system means a system of conductors in which at least one conductor or point (usually the middle wire, or neutral point of transformer or generator windings) is intentionally grounded, either solidly or through a current-limiting device.

Guarded means covered, shielded, fenced, enclosed, or otherwise protected, by means of suitable covers or casings, barrier rails or screens, mats or platforms, to remove the liability of dangerous contact or approach by persons or objects to a point of danger.

Insulated means separated from other conducting surfaces by a dielectric substance or air space permanently offering a high resistance to the passage of current and to disruptive discharge through the substance or space.

Note: When any object is said to be insulated, it is understood to be insulated in suitable manner for the conditions to which it is subjected. Otherwise, it is, within the purpose of these rules, uninsulated. Insulating covering of conductors is one means for making the conductors insulated.

Insulating (where applied to the covering of a conductor, or to clothing, guards, rods, and other safety devices) means that a device, when interposed between a person and current-carrying parts, protects the person making use of it against electric shock from the current-carrying parts with which the device is intended to be used; the opposite of conducting.

Lightning arrester means a device which has the property of reducing the voltage of a surge applied to its terminals, is capable of interrupting follow current if present, and restores itself to its original operating conditions.

Rural districts means all places not urban, usually in the country, but in some cases within city limits.

Service means the conductors and equipment for delivering electric energy from the secondary distribution or street main, or distribution feeder, or from the transformer, to the

wiring system of the premises served. For overhead circuits, it includes the conductors from the last line pole to the service switch or fuse. The portion of an overhead service between the pole and building is designated as "service drop."

Switch means a device for opening and closing or for changing the connection of a circuit. In these rules a switch will always be understood to be manually operated, unless otherwise stated.

Transformer vault means an isolated inclosure either above or below ground with fire-resistant walls, ceiling, and floor, in which transformers and related equipment are installed, and which is not continuously attended during operation.

Urban districts means thickly settled areas (whether in cities or suburbs) or where congested traffic often occurs. A highway, even though in the country, on which the traffic is often very heavy, is considered as urban.

Voltage (of a circuit) means the highest effective voltage between any two conductors of the circuit concerned.

Exception: Voltage of a grounded multiwire circuit, not exceeding 750 volts between any two conductors, means the highest effective voltage between any wire of the circuit and that point or conductor of the circuit which is grounded.

If one circuit is directly connected to another circuit of higher voltage (as in the case of an autotransformer), both are considered as of the higher voltage, unless the circuit of lower voltage is effectively grounded, in which case its voltage is not determined by the circuit of higher voltage. Direct connection implies electrical connection as distinguished from connection merely through electromagnetic or electrostatic induction.

Voltage to ground of a grounded circuit means the highest effective voltage between any conductor of the circuit and that point or conductor of the circuit which is grounded. For ungrounded circuits it means the highest effective voltage between any two conductors of the circuit concerned.

Voltage to ground of a conductor of a grounded circuit means the highest effective voltage between such conductor

and that point or conductor of the circuit which is grounded. For ungrounded circuits it means the highest effective voltage between such conductor and any other conductor of the circuit concerned.

Wire gages: The American Wire Gage (AWG), otherwise known as Brown & Sharpe (B&S), is the standard gage for copper, aluminum, and other conductors, excepting steel, for which the Steel Wire Gage (Stl. WG) is used throughout these rules.

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SEC. 50. SCOPE

500. SCOPE.

The rules of part 5 apply to radio-transmitting and receiving installations, including antennas, counterpoise wires, lead-in conductors, grounding conductors, grounding connections, protective devices, and batteries. The rules do not apply to mobile or portable installations of any type, nor to equipment and coupling wires used for coupling carrier-current equipment to supply-line conductors. In case the installation is covered by more than one rule, the superior requirement shall apply.

SEC. 51. CLASSIFICATION OF RADIO STATIONS

510. CLASSIFICATION OF RADIO STATIONS.

For the purpose of these rules, radio stations are classified as follows:

A. Receiving stations.

B. Transmitting stations.

The power rating of transmitters shall be the rating authorized by the Federal Communications Commission or other authorized Federal regulatory body in granting construction permits and licenses. For the purpose of this code, transmitting stations are divided into three groups as follows:

1. LOW POWER.

   Transmitting stations having a licensed operating power less than 100 watts and a maximum plate supply voltage (dc or rms ac) less than 750 volts.

2. MEDIUM POWER.

   Transmitting stations not classified as low power or high power.

500. B. Transmitting stations—Continued.

3. HIGH POWER.

Transmitting stations having a licensed operating power greater than 1,000 watts or a maximum plate supply voltage (dc or rms ac) greater than 5,000 volts.

Note: In the case of amateur stations, the classification under these rules shall be determined by the voltage used on the plate of the last tube of the transmitter.

SEC. 52. ANTENNA AND COUNTERPOISE INSTALLATION

520. APPLICATION OF RULES.

These rules apply as follows:

A. Outdoor Antennas of All Classes of Stations (as defined in 510, A and B).

There are no requirements for indoor antennas, except that they shall meet the requirements for clearance from the conductors of other systems specified in rule 533, C. In general, transmitting antennas should not be located indoors.

B. Counterpoise Wires.

C. Ground-System Wires.

There are no requirements for the ground-system wires of an antenna.

521. GENERAL REQUIREMENTS.

A. Antennas.

1. ANTENNAS OF RECEIVING STATIONS.

Such antennas shall comply with the requirements for the construction of communication lines for public use in similar situations, as given in part 2 of this code.

2. ANTENNAS OF TRANSMITTING STATIONS.

Such antennas shall comply with the requirements for the construction of supply lines for public use in comparable situations and for the voltage concerned, as given in part 2 of this code.

521. General Requirements—Continued.

B. Counterpoise Wires.

Counterpoise construction shall conform to the requirements for that of the associated antenna as regards location and clearances with respect to conductors of other systems.

522. Locations to be Avoided.

A. Medium and High-Power Transmitting Stations.

The following situations shall be avoided in erecting the antenna, counterpoise, and guy-wire systems of medium and high-power transmitting stations:

1. Attachment of any wires of the systems to poles which carry the conductors of any electric supply or communication circuits.
2. Crossings (above or below) or conflicts of any of the wires of the systems with the conductors of any electric supply or communication circuits.
3. Crossing over streets, highways, or the tracks of any railroad.

B. Receiving and Low-Power Transmitting Stations.

1. In relation to circuits of more than 250 volts—The following situations shall be avoided in erecting the antenna, counterpoise, and guy-wire systems of receiving and low-power transmitting stations, except for the equipment of public utilities attached to their own poles:

   (a) Attachment of any wires of the systems to poles which carry electric supply or communication circuits of more than 250 volts to ground.

   (b) Crossings (above or below) or conflicts of any of the wires of the systems with the conductors of any electric supply or communication circuits of more than 250 volts to ground.

522. B. Receiving and Low-Power Transmitting Stations—Continued.

2. In relation to circuits of less than 250 volts—

The following situations should be avoided whenever possible in erecting the antenna, counterpoise, and guy-wire systems of receiving and low-power transmitting stations, except for the equipment of public utilities attached to their own poles:

(a) Attachment of any wires of the systems to poles carrying the conductors of electric supply or communication circuits, none of which exceeds 250 volts to ground.

(b) Crossings or conflicts of any wires of the systems with the conductors of any electric supply or communication circuits of less than 250 volts to ground.

(c) Crossing over streets, highways, or the tracks of any railroad.

523. Ordinary Construction of Antenna Systems.

If all of the situations listed in rule 522 are avoided, antenna systems should be constructed in accordance with rule 523. If any of the situations of rule 522, B, 2, are not avoided, antenna systems shall be constructed in accordance with rule 524.

A. Antenna Conductors.

1. MATERIAL.

Antenna conductors should be of copper, copper-covered steel, bronze, or other corrosion-resistant material of adequate strength.

2. SIZE.

Antenna conductor sizes should be not less than given in table 1.

523. A. Antenna Conductors—Continued.

TABLE 1.—*Antenna conductor sizes—ordinary construction*

Material	Receiving and low-power transmitting			Medium and high-power transmitting		
	Span length			Span length		
	Less than 35 feet	35 to 150 feet	Exceeding 150 feet	Less than 35 feet	35 to 150 feet	Exceeding 150 feet
	AWG No.	*AWG No.*	*AWG No.*	*AWG No.*	*AWG No.*	*AWG No.*
Copper:						
Soft-drawn	19	14	8	14	7	---
Medium-drawn	19	14	10	14	8	---
Hard-drawn	19	14	12	14	10	8
Bronze, copper-covered steel, or other high-strength, corrosion-resistant material	19	14	14	14	12	10

3. STRENGTH.

The conductor sizes listed in table 1 provide for minimum strength without loading. In localities subject to glaze, ice, sleet, or snowstorms, comprised in the heavy- and medium-loading districts, additional strength should be provided. (See rule 250.) In determining the loading, the effect of lead-in conductors and the loading thereon should be included.

B. Antenna Insulators.

1. MATERIAL.

Insulators should be of noncombustible material.

2. DIELECTRIC STRENGTH.

(*a*) ***Receiving and Low-Power Transmitting Stations.*** No requirements.

(*b*) ***Medium and High-Power Transmitting Stations.*** Insulators should meet the requirements of rule 274 for the voltage developed on the antenna at the points of insulator attachment.

523. B. Antenna Insulators—Continued.

3. MECHANICAL STRENGTH.

Insulators should have a breaking strength not less than that of the smallest conductor which would be permitted by table 1.

C. Antenna Supports.

1. STRENGTH OF SUPPORTS.

All supporting structures should be so constructed as to carry the vertical, longitudinal, and transverse loads. They should be so erected that they are not dependent in general on the antenna for stability. Guys or braces may be used to obtain the necessary strength to withstand the longitudinal and transverse loads. Where the stability of the support is solely dependent on the guys, these should be led out in at least three approximately equally spaced directions from the support. In determining the loads, the storm-loading map given with rule 250 should be employed; also the effect of the lead-in conductors and the load thereon should be included.

Exception: If ice-melting arrangements are regularly utilized, ice loading may be disregarded.

2. GUYS.

Guys should be of galvanized steel, copper-covered steel, bronze, or other corrosion-resistant material, and should be of adequate size, and in any case not less than No. 14 AWG. They should be firmly attached to adequate anchors or to structures which will furnish a substantial anchorage. Where guys may be exposed to mechanical damage they should be provided with guards. Guys associated with antennas of transmitting stations where accessible to unauthorized persons shall be grounded or contain insulators complying with rule 283.

523. C. Antenna Supports—Continued.

3. ROOF SUPPORTS.

Antenna supports erected on roofs should be of substantial construction and, where necessary, shall be arranged to distribute the load over the roof.

4. CHIMNEYS.

The attachment of antennas or antenna supports to chimneys shall be avoided where such attachment might overload the chimney.

5. GROUNDING METAL SUPPORTS ON ROOFS.

Metal supporting poles or masts extending more than 10 feet above the supporting building shall be permanently and effectively grounded in conformance with the requirements of section 56, except poles or masts which themselves are used as antennas.

6. TREES.

Where antennas or guys are attached to trees, the location and method of attachment shall be such that swaying of the tree in the wind will not cause undue stress in the antenna conductors.

D. Strength of Attachment of Antennas to Supports.

The means used for attaching the antenna to the support shall be such as to withstand a load that will break the conductor itself. The use of a strain hook which will release the wire before it breaks is permissible if the circumstances of a particular installation warrant it.

E. Minimum Clearance above Ground and Roofs.

1. SPANS 150 FEET OR LESS IN LENGTH.

Antenna conductors in approximately horizontal spans shall have clearances above ground and roofs not less than given in table 2. These clearances do not apply to vertical antennas, or vertical lead-ins.

523. E. Minimum Clearance above Ground and Roofs—Continued.

TABLE 2.—*Minimum antenna clearances above ground or roof*

Location	Receiving and low-power antennas	Medium and high-power antennas
	Feet	*Feet*
Above roofs	8	8
Along road in rural districts	15	28
Above streets and roadways	18	28
Above roadways to residence garages	10	12
Above spaces or ways normally accessible to pedestrians only	10	12

2. SPANS EXCEEDING 150 FEET IN LENGTH.

For such spans the above clearances shall be increased by 0.1 foot for each 10 feet in excess of 150 feet.

524. SPECIAL CONSTRUCTION OF ANTENNA SYSTEMS.

Where any of the situations (a), (b), and (c) of rule 522, B, 2, are not avoided, the construction shall meet such of the following rules as may apply.

A. Recommendation Against Locating Antennas in Situations Where Special Construction is Required.

It is strongly recommended that the installation of antennas in these special situations be avoided.

Note: If such locations are employed, it must be recognized that special hazards are introduced and that great care is necessary in the construction and maintenance of antennas to avoid contact with supply or communication conductors and to avoid the reduction of clearance over highways or railroad tracks.

B. Attachment to Poles Carrying Conductors of Electric Supply or Communication Circuits of Less than 250 Volts to Ground.

The attachment to such poles shall be made in such a manner and at such a location on the pole as not to interfere with the operation or maintenance of the electric supply or communication circuits,

524. B. Attachment to Poles Carrying Conductors of Electric Supply or Communication Circuits of Less than 250 Volts to Ground—Continued.

and to provide a clearance of at least 40 inches below the conductors and equipment of the electric supply or communication circuits. The antenna conductor, counterpoise, or guy wires preferably should be attached below the foreign circuit attachments.

Exception: These requirements do not apply in the case of outdoor installations of radio equipment and antennas where the electric supply or communication circuits terminate in the radio equipment.

C. Crossings Over or Conflicts With Electric Supply or Communication Circuits of Less than 250 Volts to Ground.

In such locations the antenna conductors, counterpoise, or guy wires shall be constructed in accordance with the provisions of rule 523, and, in addition, a clearance of 6 feet shall be maintained at the crossing or throughout the conflicting section.

D. Crossings Under Electric Supply or Communication Circuits of Less than 250 Volts to Ground.

In such locations the antenna conductors, counterpoise, or guy wires shall be constructed in accordance with the provisions of rule 523, and, in addition, they shall be so constructed as to insure the maintenance of at least 2 feet from a communication conductor and of 4 feet from an electric supply conductor.

Note: It should be noted that for relatively long spans on the electric supply or communication circuit, the increase in sag with ice and wind loading is considerably more than for short spans, and allowances should be made accordingly when determining the clearance under fair-weather conditions.

524. Special Construction of Antenna Systems—Continued.

E. Crossings Over Streets, Highways, or Railway Tracks.

In such locations the antenna conductors, counterpoise, or guy wires shall be constructed in accordance with the provisions of rule 523 and, in addition, shall meet the requirements of part 2 for the strength and sag of conductors, strength of supports, and clearance above the roadway applicable to communication lines in such locations. Where the requirements of rule 523 differ from those of part 2, the requirements of part 2 shall control.

525. Guarding of Antennas.

Antennas for transmitting stations except those of the shunt-excited, grounded-base type shall be installed so as not to be readily accessible to unauthorized persons.

526. Supply Circuits as Antennas or Grounds.

Electric supply circuits shall not be employed as receiving antennas or as operating grounds through a conductive connection. They may be so used if suitable capacitors having a dielectric strength sufficient to withstand seven times the normal supply-circuit voltage and a capacitance of not more than 0.1 microfarad are inserted between the apparatus and each wire of the supply circuit.

SEC. 53. LEAD-IN CONDUCTORS

530. Application of Rules.

The requirements of this section apply to lead-in conductors (including radio-frequency transmission lines) of receiving stations and low-power transmitting stations. Lead-in conductors of medium and high-power transmitting stations shall meet such of the requirements of part 1, supply stations, as apply for the voltages concerned.

531. Material.

Lead-in conductors shall be of copper, bronze, copper-covered steel, or other corrosion-resistant material.

532. Size.

The size of the lead-in conductor should not be less than that specified in table 1, the span length being taken as the distance from the point of attachment to the antenna to the first building attachment. Where the lead-in conductors are attached to intermediate supports, the maximum span shall be considered.

533. Installation of Lead-in Conductor.

A. From Antenna to First Building Attachment.

This section of the lead-in wire shall conform to the requirements as specified in rules 523 and 524 for antennas similarly located.

B. From First Building Attachment to Building Entrance.

This section of the lead-in conductor shall be installed and maintained so that it cannot swing closer to the open conductors of communication, supply, or lightning-rod systems than the following distances:

Communication or supply circuits of 0 to 750 volts	2 feet.
Supply circuits exceeding 750 volts	10 feet.
Lightning-rod systems	6 feet.

Exception: The 2-foot clearance from communication or supply circuits of less than 750 volts may be reduced to not less than 4 inches if the lead-in conductor is separated from other conductors by a continuous and firmly fixed nonconductor which will maintain permanent separation. This nonconductor shall be in addition to any insulating covering on the wires.

Lead-in conductors of low-power transmitting stations shall be firmly mounted on insulating supports so as to clear by at least 3 inches the surface of the building. If the lead-in has an effectively grounded metal sheath, it may be attached directly to the surface and treated as a grounding conductor with respect to clearance and other requirements.

533. Installation of Lead-in Conductor—Continued.

C. From Building Entrance to Set.

1. RECEIVING STATIONS.

(a) Lead-in conductors shall be securely fastened in a workmanlike manner.

(b) Clearance between lead-in conductor and any supply conductor not in conduit shall not be less than 4 inches.

Exception 1: This 4-inch clearance does not apply if a firmly fixed nonconductor such as a porcelain tube affords a permanent separation. This nonconductor shall be in addition to any insulating covering on the wires.

Exception 2: This 4-inch clearance does not apply where the lead-in terminates in an outlet box which is also occupied by the conductors of another system, provided such outlet box is equipped with a barrier of sheet steel not less than No. 16 U. S. Standard Gage or a barrier of fire-resistant insulating material rigidly fastened to the box or its cover, or other device which assures positive separation between the lead-in conductors and the conductors of the other system.

2. LOW-POWER TRANSMITTING STATIONS.

(a) Lead-in conductors shall be securely fastened to suitable insulators which provide a clearance of at least 2 inches to the nearest surface.

(b) Clearance between lead-in conductor and any supply wire shall be at least 4 inches.

(c) Lead-in conductors shall be installed and protected to prevent persons from readily coming into accidental contact with them.

533. C. 2. Low-Power Transmitting Stations—Continued.

Exception: If the lead-in has an effectively grounded metal sheath, it may be treated as a grounding conductor and attached directly to any surface.

SEC. 54. CONSTRUCTION AT BUILDING ENTRANCE

540. Application of Rules.

The requirements of this section apply to construction at receiving stations and low-power transmitting stations. Construction at building entrance of medium- and high-power transmitting stations shall meet such of the requirements of part 1, supply stations, as may apply for the voltage concerned.

541. Entrance.

A. Receiving Stations.

Lead-in conductors for receiving stations shall be either insulated or surrounded by a grounded metallic sheath where they enter the building.

B. Low-Power Transmitting Stations.

Lead-in conductors for low-power transmitting stations, where not installed with a grounded metallic sheath, shall enter the building by one of the following methods: (1) through a rigid, noncombustible, nonabsorptive insulating tube or bushing; (2) through a drilled window pane; and (3) through an opening provided for the purpose in which the entrance conductors are firmly secured so as to provide a clearance of at least 2 inches. If the lead-in conductor is inclosed in an effectively grounded metal sheath, no further insulation is necessary.

542. Creepage and Air-Gap Distance.

The entrance bushing or window pane mentioned in rule 541 shall, in the case of low-power transmitting stations, afford a creepage and air-gap distance from extraneous bodies of not less than 2 inches. There is no requirement under this title for receiving stations.

543. Mechanical Protection of Bushings.

Entrance bushings of porcelain or other fragile material at low-power transmitting stations shall be protected where exposed to mechanical injury.

SEC. 55. PROTECTIVE DEVICES

550. Application of Rules.

The requirements of this section apply to protective devices for receiving stations and low-power transmitting stations. Protective devices for medium and high-power stations shall meet such of the requirements of part 1, supply stations, as may apply for the voltages concerned.

551. Receiving Stations.

A. Lightning Arrester.

Each lead-in conductor of a receiving station using an outdoor antenna shall be provided with a lightning arrester which will operate at a voltage of 750 volts or less.

Exception: If the lead-in conductor is protected by a continuous effectively grounded metal sheath, the lightning arrester may be omitted.

B. Location.

The lightning arrester may be located outside or inside the building as near as practicable to the point of entrance and convenient to a ground. The arrester shall not be placed in the immediate vicinity of easily ignitible material nor in a location exposed to dust, inflammable gases, or flyings of combustible materials.

552. Low-Power Transmitting Stations.

A. Protective Device.

Lead-in conductors of low-power transmitting stations shall be equipped with a grounding switch, lightning arrester, horn gap, or other suitable means for lightning protection. If no conducting path between the antenna and ground is provided in the

552. A. Protective Device—Continued.

connected equipment, means shall be provided to drain static charge from the antenna system.

Exception: Where the antenna itself is directly grounded, other forms of protection against lightning and static charge may be omitted.

B. Location.

The protective device may be located either outside or inside the building. The device should be placed in the most direct line between the lead-in conductor and the point where the grounding connection is made. The device shall not be placed in the immediate vicinity of easily ignitible material nor in a location exposed to dust, inflammable gases, or flyings of combustible material.

SEC. 56. PROTECTIVE AND OPERATING GROUNDING CONDUCTORS

560. Application of Rules.

The requirements of this section apply to grounding conductors of receiving stations and low-power transmitting stations. Grounding conductors of medium and high-power transmitting stations shall meet such requirements of section 9, grounding, and part 1, supply stations, as apply.

561. General.

The protective grounding conductor may be used also as the operating grounding conductor.

562. Material and Size.

A. Receiving Stations.

1. MATERIAL.

No requirements.

2. SIZE.

(a) *Operating grounding conductor.* No requirements.

(b) *Protective Grounding Conductor.* This conductor shall be not smaller than No. 14 AWG. copper and not smaller than the lead-in conductor.

562. Material and Size—Continued.

B. Low-Power Transmitting Stations.

The operating and protective grounding conductors of low-power transmitting stations shall be not smaller than No. 14 AWG. copper, and not smaller than the lead-in conductor.

563. Installation of Grounding Conductors.

A. Method of Running.

1. Grounding conductors shall be run in as straight a line as practicable from the set or the protective device to a good effective ground as specified in section 57.
2. Grounding conductors may be run either inside or outside of the building.

Recommendation: It is recommended that the protective grounding conductor for low-power transmitting stations be run outside of the building.

B. Mechanical Protection.

Grounding conductors shall be guarded against mechanical injury.

C. Insulation.

Grounding conductors may be of insulated or bare wire and need not be run on insulating supports.

D. Fuse Not To Be Used.

No fuse shall be included in the circuit between the lightning arrester and the protective ground.

SEC. 57. GROUNDS AND GROUND CONNECTIONS

570. Application of Rules.

The requirements of this section apply to protective grounds and ground connections for receiving stations and to operating and protective grounds and ground connections of low-power transmitting stations. There are no requirements for operating grounds or ground connections for receiving stations. Grounds and ground

570. Application of Rules—Continued.

connections for medium and high-power transmitting stations shall meet such requirements of section 9, grounding, and part 1, supply stations, as apply.

571. Grounds.

A. Cold-Water Pipes.

Cold-water pipes shall preferably be used for grounds where such pipes are available and are connected or bonded to an extensive underground piping system or to a metallic well casing. An outlet pipe from a water tank fed by a street water main or a driven well may be used provided such outlet pipe is adequately bonded to the inlet pipe connected to the street water main or to the well casing.

B. Gas Pipes.

In the absence of cold-water pipes, an extensive underground gas piping system may be used provided the grounding-conductor connection is made between the gas meter and the street main.

C. Steam and Hot-Water Pipes.

Steam and hot-water pipes shall not be used for grounds.

D. Metallic Structures.

A metallic structure may be used as a ground, if effectively grounded.

E. Artificial Grounds.

In the absence of underground piping systems, driven pipes or rods or buried plates may be used. Steel or iron pipes or rods shall be galvanized or copper-coated.

572. Attachment to Pipes.

Grounding conductors shall be attached to pipes by means of suitable ground clamps which will not fail because of corrosion or cause corrosion of the pipe, or by other means which will insure a good mechanical and electrical connection. The entire surface of the

572. Attachment to Pipes—Continued.

pipe to be covered by the clamp shall be thoroughly cleaned. Connections to such pipes shall not be made at the same point as used for grounding electric supply or communication circuits or equipment.

573. Attachment to Driven Pipes, Rods, or Buried Plates.

The grounding conductor shall be attached to the rod, buried plate, or other body so as to give a reliable connection both mechanically and electrically. This connection shall be made so that it will not fail through corrosion even when the joint is buried in the earth. Driven pipes or rods or buried plates used as grounding electrodes shall not be used also as grounding electrodes for electric supply or communication circuits or equipment. This requirement, however, does not prohibit the bonding together of the grounds of these several services where such bonding seems desirable. Where an effective station ground has been established by bonding together a group of such driven pipes or rods or buried plates, connection may be made thereto even though this ground is also used for other services.

SEC. 58. CONNECTION TO POWER SUPPLY LINES

580. Application of Rules.

The requirements of this section shall apply to connecting devices for receiving stations and low-power transmitting stations. Connecting devices for medium and high-power transmitting stations shall meet such requirements of part 1, supply stations, as may apply.

581. Receiving Stations and Low-Power Transmitting Stations.

Devices used in connection with power supply lines and methods of wiring employed at receiving stations and low-power transmitting stations shall be in accordance with the rules covering permanent or portable fixtures, devices, and appliances of part 3, sec. 37.

SEC. 59. BATTERIES

590. Application of Rules.

The requirements of this section apply to batteries for receiving stations and transmitting stations of low and medium power. Large permanently installed batteries with a nominal voltage in excess of 50 volts, and batteries for high-power transmitting stations shall conform to section 13, part 1, rules for stations.

591. Care in Handling.

Care shall be used in handling batteries in order to avoid contacts with terminals having a high enough difference of potential to cause shock.

592. Portable Batteries.

A. Ventilation.

Storage batteries shall be located where there is adequate ventilation.

B. Precautions.

Smoking, or the use of open flames, or of tools which may generate sparks, should be avoided except when cells are not actively gassing and when prior ventilation has been ample. Sparks from frictional or static electricity should be avoided, as they may ignite the gas if discharged close to its source, as at the vent of a sealed-type cell during overcharging. The electrolyte of storage batteries, and spray containing electrolyte, are somewhat corrosive, particularly when concentrated by evaporation, and contact with body or clothes should be avoided.

Do not handle live parts of batteries or their connections unless adequate precautions are taken to avoid shock.

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